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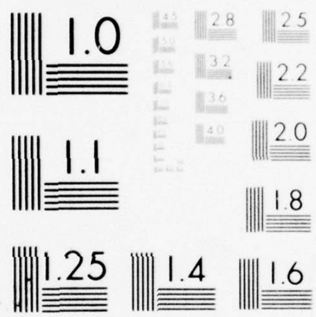

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SECOND QUARTERLY PROGRESS REPORT

FOR

MANUFACTURING METHODS AND TECHNOLOGY (MMTE)

MEASURE FOR FABRICATION OF LOW VOLTAGE

START SEALED BEAM ARC LAMPS

1 September 1976 TO 30 November 1976

CONTRACT NO. DAAB07-76-C-0034

U.S. Army Electronics Command
Production Division
Production Integration Branch
Ft. Monmouth, NJ 07703

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

A program is in progress to establish a production capability for the purpose of meeting estimated military needs for the X6335, a 1kW sealed beam xenon arc lamp with low voltage starting mechanism. In accordance with the requirements of the contract, the first engineering sample lamp was delivered. A modification was made in the structual design of the Second Engineering Sample to correct a dimension problem on the First Engineering Sample. over

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Additional refinements have been implemented to the second engineering sample for test and evaluation. A test device "Driving Circuit Test Device" was designed and fabricated for testing of lamp burn-in and lamp ignition requirements. This test device will aid in achieving the specified requirements.

MANUFACTURING METHODS AND TECHNOLOGY (MMTE)

MEASURE FOR FABRICATION OF LOW VOLTAGE

START SEALED BEAM ARC LAMPS

SECOND QUARTERLY PROGRESS REPORT

1 September 1976 TO 30 November 1976

"The objective of this manufacturing methods and technology project is to establish the technology and capability to fabricate Low Voltage Start Sealed Beam Arc Lamps".

CONTRACT NO. DAAB07-76-C- 0034

By

Edwin Chan
Tim Bell

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ABSTRACT

A program is in progress to establish a production capability for the purpose of meeting estimated military needs for the X6335, a 1kW sealed beam xenon arc lamp with low voltage starting mechanism.

In accordance with the requirements of the contract, the first engineering sample was delivered.

A modification was made in the structual design of the Second Engineering Sample to correct a dimension problem on the First Engineering Sample. Additional refinements have been implemented to the second engineering sample for test and evaluation.

A test device, "Driving Circuit Test Device", was designed and fabricated for testing of lamp burn-in and lamp ignition requirements. This test device will aid in achieving the specified requirements.

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1.0 PURPOSE

The objective of this program is to establish a production capability for the purpose of meeting estimated military needs for a period of two (2) years after completion of the contract, and to establish a base and plans which may be used to meet expanded requirements.

The program is intended to demonstrate and to "prove-out" the manufacturing processes, methods and techniques that are utilized in the production of 1kW sealed beam xenon arc lamps with a low voltage starting mechanism.

The lamp initially chosen for the program was the X6257. This lamp has been produced for military searchlight applications. The high voltage version of this lamp was developed initially under Contract Number DAAK02-68-C-0215. The 1kW lamp was further refined on a PEM Contract Number DAAB05-71-C-2609. The low voltage starting X6257 was not developed with government funds, but was developed with EIMAC funds.

This contract is divided into three phases:

1. Engineering Samples, wherein modifications are being made to designs arrived at under previous development in order to improve their optical performance, safety and utility in the field and to reduce their cost. Production drawings, procedures, and tooling will also be developed. These parameters will be based on delivery of three (3) samples.
2. Confirmatory Samples, wherein the delivery of three (3) units will be made to demonstrate that lamps can be made with production techniques and procedures to meet the specification.

3. Pilot Run, wherein the delivery of thirty (30) units be made to demonstrate the capability of meeting the planned production rate.

The Engineering Sample Phase is needed in order to allow for incorporation of features which will make the lamp start more reliably, be easier to fabricate, be safer to operate, have a highly accurate mounting surface for optical reference and afford cost reduction.

Problem areas anticipated are the following:

1. Bearing surfaces for movable stinger
2. Accurate cathode tip location relative to the reflector focal point
3. Starting reliability of the lamp.

During the first quarter the first engineering sample was delivered. This lamp met the contractual specifications for length but did not meet the contractual specifications for the length of the main housing assembly. Appropriate steps have been initiated to obtain a change in the contractual specifications.

Additionally, during this quarter a burn-in ignition test device was fabricated and is undergoing evaluation.

2.0 GLOSSARY

LVS..............................Low voltage starting

Stinger.........................Moveable electrode used for lamp ignition

Reflector Mandrel...............A stainless steel tool which is polished to a mirrored surface with a precise elliptical contour upon which the reflector is electroformed.

EI (characteristic).............The voltage (E) across the lamp for a given current (I) passing through the lamp.

3.0 NARRATIVE AND DATA

The lamp is comprised of conventional tungsten electrodes positioned in a ceramic/metal structure with a reflector and sapphire window. The arc is located at the focal point of the reflector so that a directed beam is obtained coaxial with the electrodes. The low voltage starting mechanism includes a moveable electrode called the "stinger" which is coaxial with the anode. Figure 1 is the view of the X6335 as the second engineering sample.

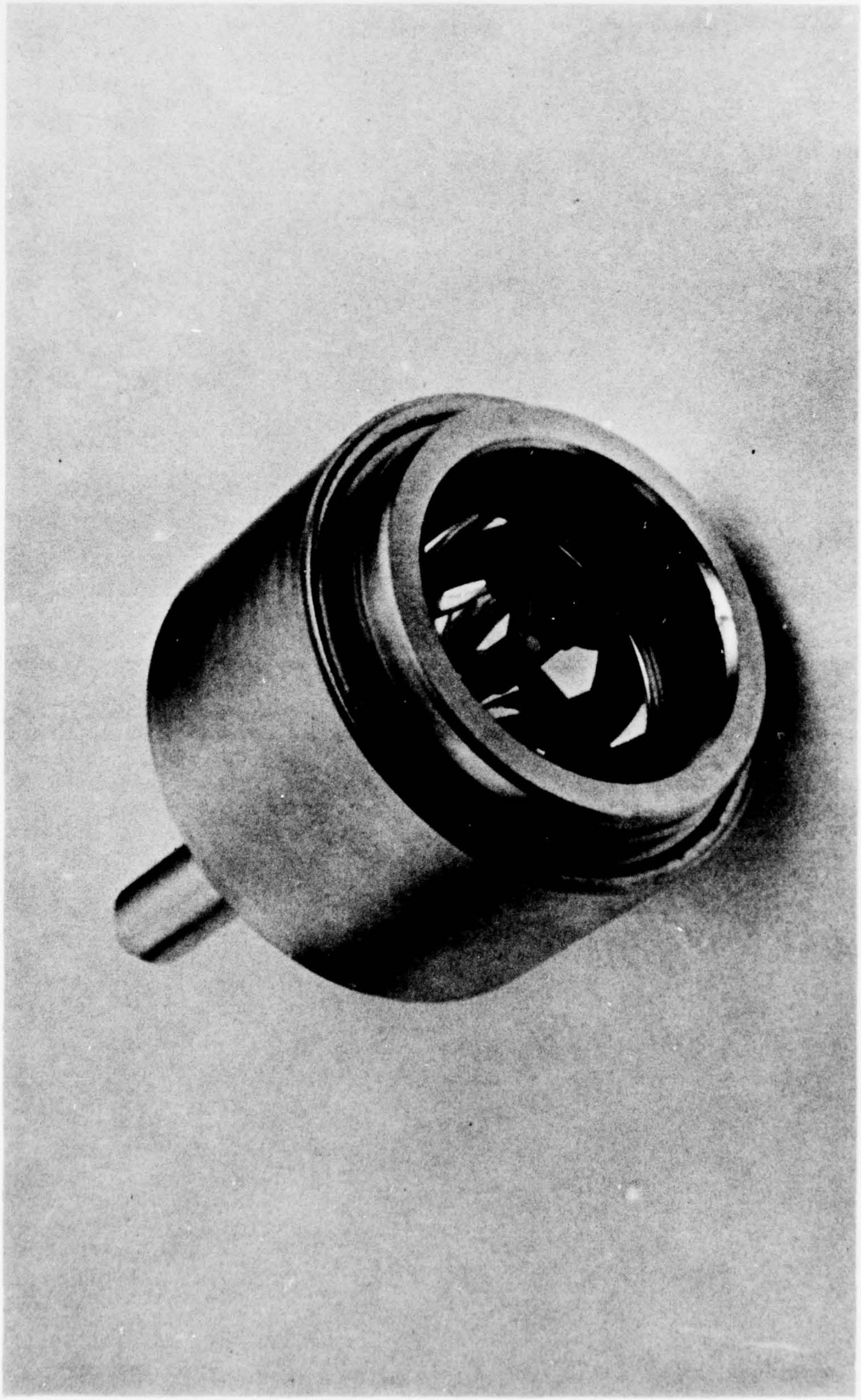
The lamp is filled with up to 20 atmospheres of high purity xenon at room temperature. The lamp's spectral output is a typical high pressure xenon arc spectrum as reflected from a silver mirror and transmitted through a sapphire window; the wavelength range is about 130nm to 6500nm. The silver reflector coating was selected for maximum output in the visible and near IR bands.

The lamp operating voltage is 19 volts D.C. $\pm 10\%$. The lamp voltage is determined primarily by the interelectrode gap and the lamp pressure. The lamp acts much like a constant voltage device, that is, large changes in current result in small changes in operating voltage. A sketch of the lamp ignition circuit is shown in Figure 2. Ignition is accomplished by use of the stinger. To commence the start cycle, the solenoid voltage is applied causing the stinger to move forward. The moment the stinger contacts the cathode tip, the electrical circuit is completed and current begins to flow through the choke. After approximately 1 second, the solenoid voltage is removed and the stinger starts to return to its deenergized position, thus breaking the circuit. At this time, the stored energy in the choke is dumped into the arc. The stinger then draws this arc back and transfers the arc to the anode.

3.0 NARRATIVE AND DATA/CONTINUED

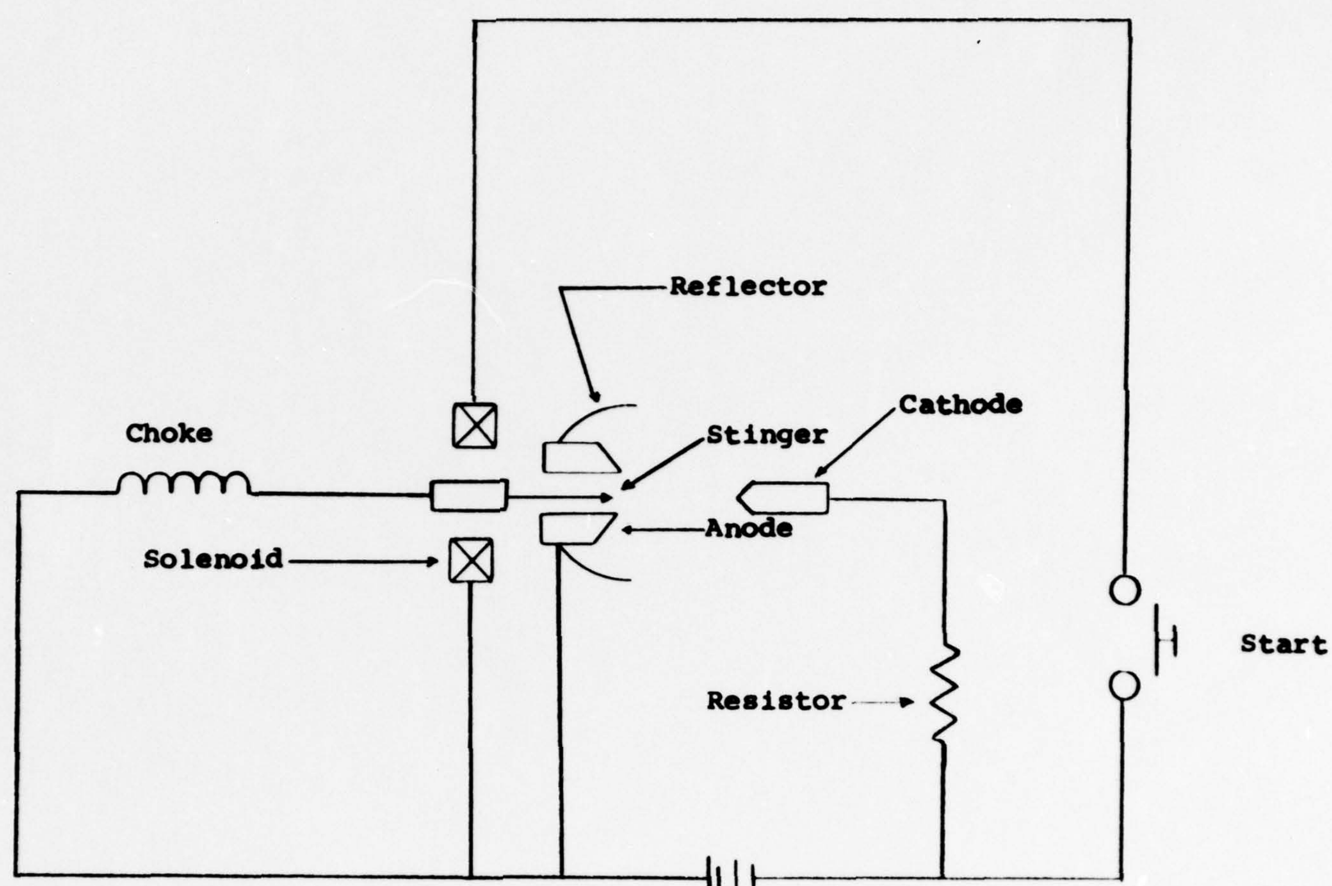
Some difficulty was encountered during the fabrication of the first engineering sample. To rectify this difficulty the overall length of the lamp was increased by approximately ¼ inch. The second engineerng sample incorporated changes which corrected this difficulty. As a result the overall lamp length is again within the five inches specified in the contract. However, the length of the lamp body on this second engineering sample still exceeds the contractual limits by approximately 1/8 inch.

The appropriate steps to obtain a contractual change to the specifications have been initiated. Figure 3 shows the outline dimensions requried by the specifications and the dotted outline shows the present configuration of the second engineering sample.



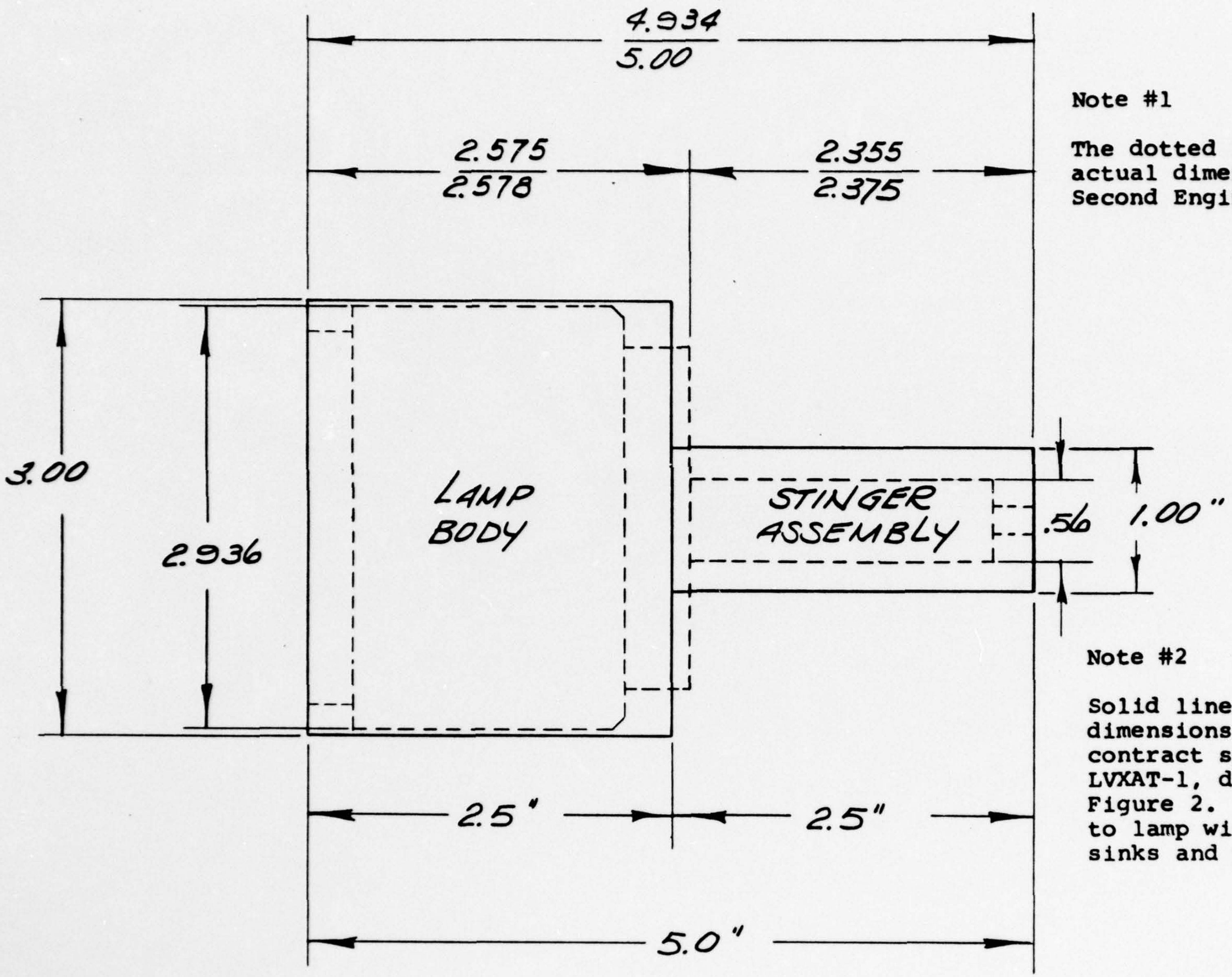
Second Engineering Sample

Figure 1



Simplified Lamp Operating Circuit

Figure 2



Note #1

The dotted lines denote actual dimensions of the Second Engineer Sample.

Note #2

Solid line is the max. dimensions taken from contract specifications, LVXAT-1, dated 15Jul75, Figure 2. (Applicable to lamp without heat sinks and pinchoff)

Outline Dimensions

Figure 3

3.1 DESIGN AND ANALYSIS

During the fabrication of first subassemblies a problem occurred during brazing cycles. The window braze was initially leak tight but when the cathode strut assembly was brazed to the window assembly, the window seal developed a leak. The same situation occurred in the anode base assembly. The problem was traced to the three sealing rings which make the knife edge seal at the sapphire and at the ceramic. Figure 4 shows the location of these sealing rings.

The initial design called for Kovar rings that were .125 inches high with a .025 inch wall. The stiffness of the material and the fillet which resulted from the braze material caused seal failure during repeated brazing cycles. The problem was solved by changing the sealing ring material from Kovar to nickel, and by increasing the ring height from .125 inches to .250 inches. This modification was made to existing first engineering sample parts in order to accomodate the new sealing rings. This, however, resulted in the lamp growing in overall length, and thus exceeding the overall length specified in the contract by approximately ¼ inch.

The refinements to the first engineering sample have been implemented. Figure 5 shows the current design of the X6335. The areas of refinement are discussed, and a description and explanation for the changes are provided in numerical order:

1. A step is machined in the outer shell which allows the cathode-reflector-window assembly to bottom onto a flat surface. This insures that the assembly is not cocked which would result in electrode misalignment. The depth of the step is designed to include a shim ring which allows achievement of a precise inter-electrode gap spacing.

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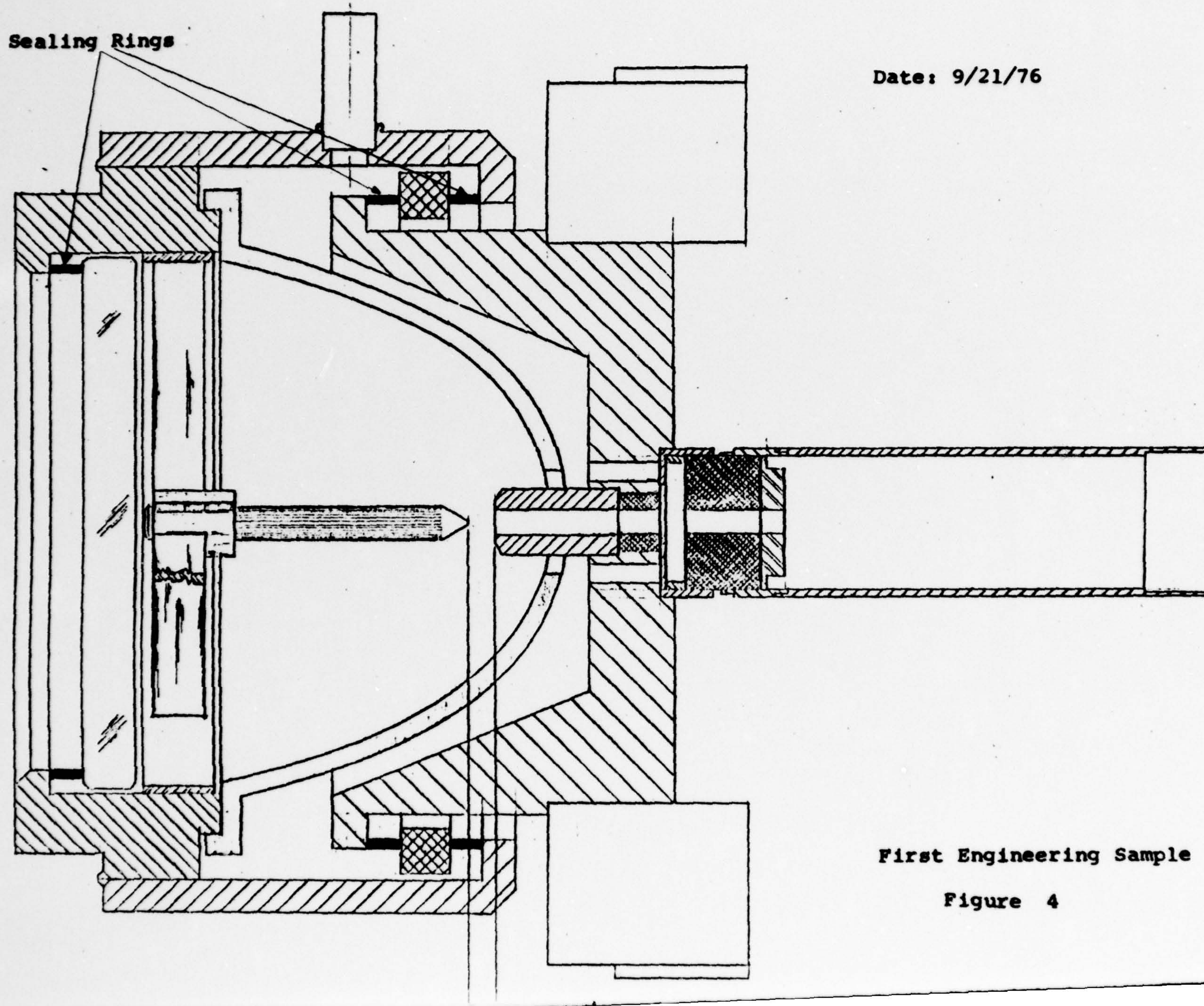
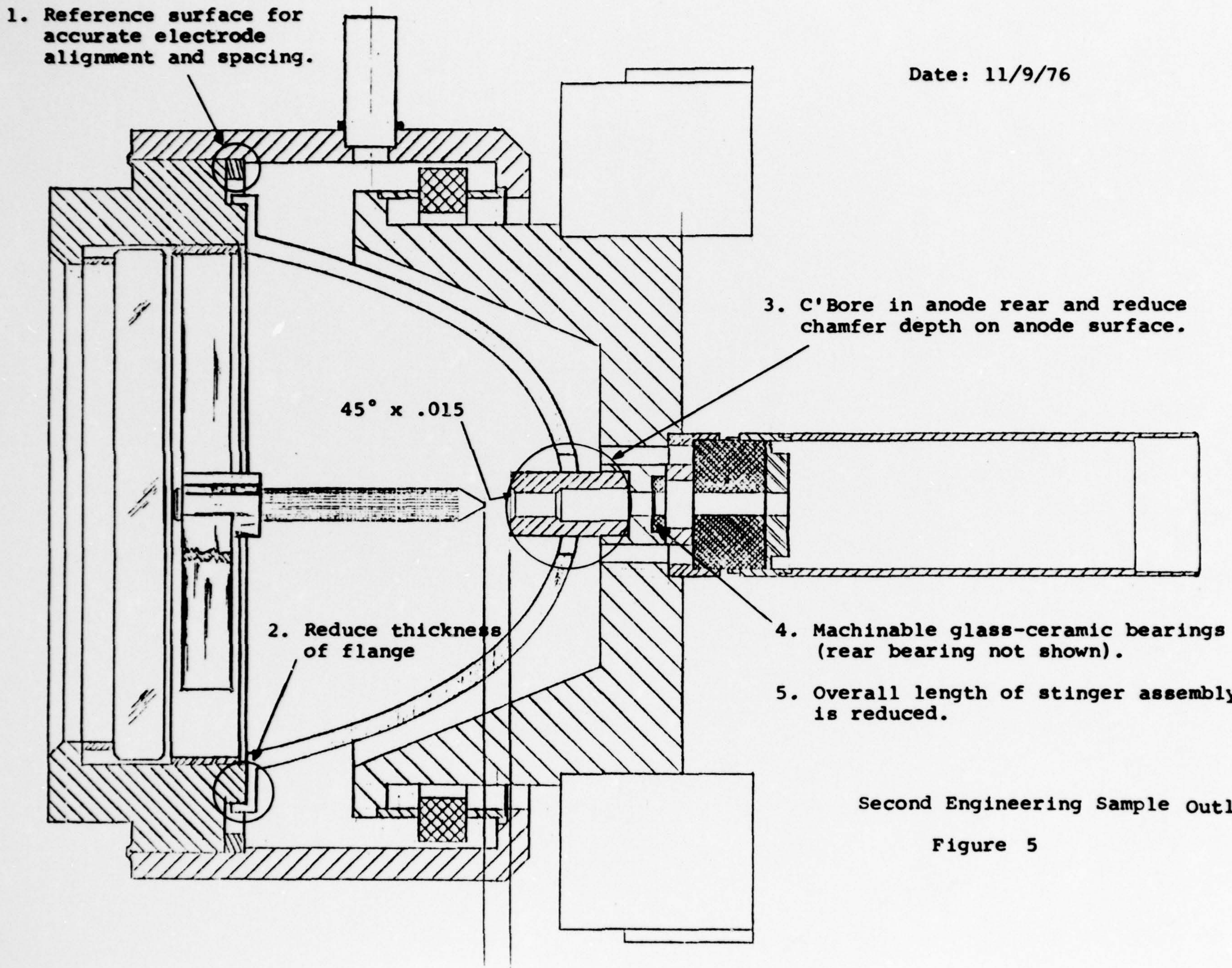


First Engineering Sample

Figure 4

Date: 11/9/76



Second Engineering Sample Outline

Figure 5

2. The reflector, as electroformed, has a flange thickness of approximately .060 inches. This thickness is too great for the subsequent welding operation. This problem has been solved by machining off excess material on the reflector flange.

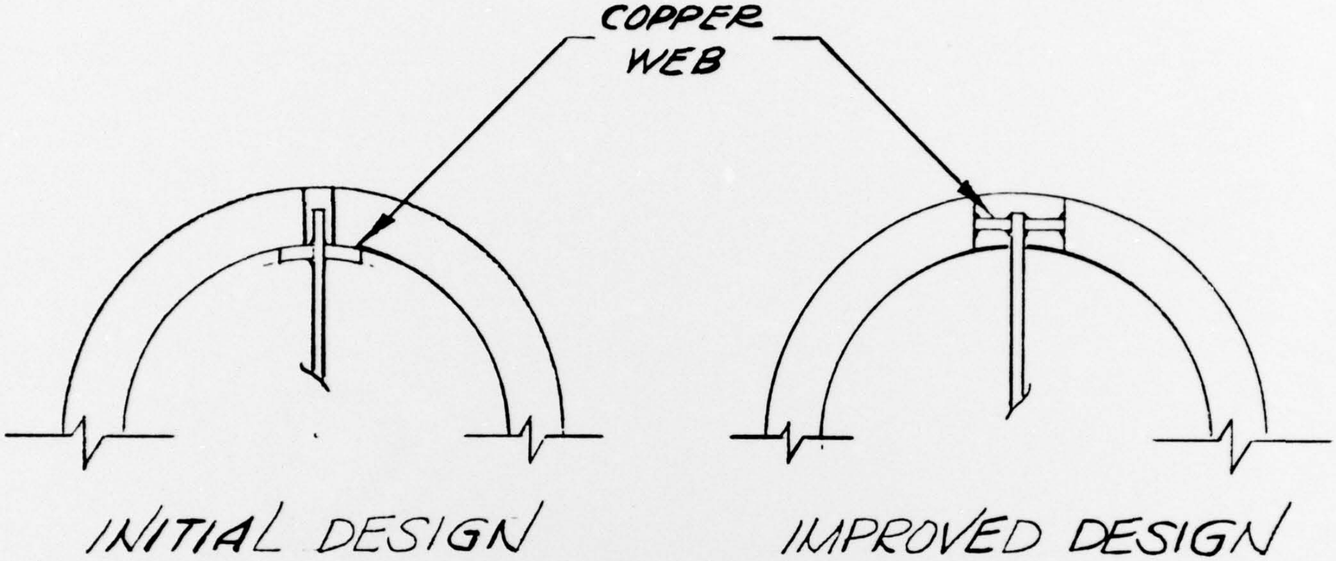
3. The first engineering sample had a chamfer on the anode I.D. of 45° x .030". This has now been reduced to 45° x .015". The change is intended to reduce the lamp operating voltage.

   A counterbore has been added to the rear of the anode. This is intended to reduce the possibility of arcing between the anode and the stinger. A critical area of the stinger is the region which contacts the bearing during the stinger travel. This region will be protected from arcing by the counterbore.

4. The quartz bearings which were used on the first engineering sample have been discontinued because this tended to chip. The new material now being used for this bearing is a machinable glass-ceramic called MARCOR which is manufactured by Corning.

3.1.1 Copper Web

Additional refinement involved the copper webs which connect the cathode strut to the window assembly. The principle reason for this change was to simplify the brazing fixtures. Figure 6 shows the initial design and the improved design which was used in the first engineering sample.



Copper Web

Figure 6

3.1.2 DRIVING CIRCUIT TEST DEVICE

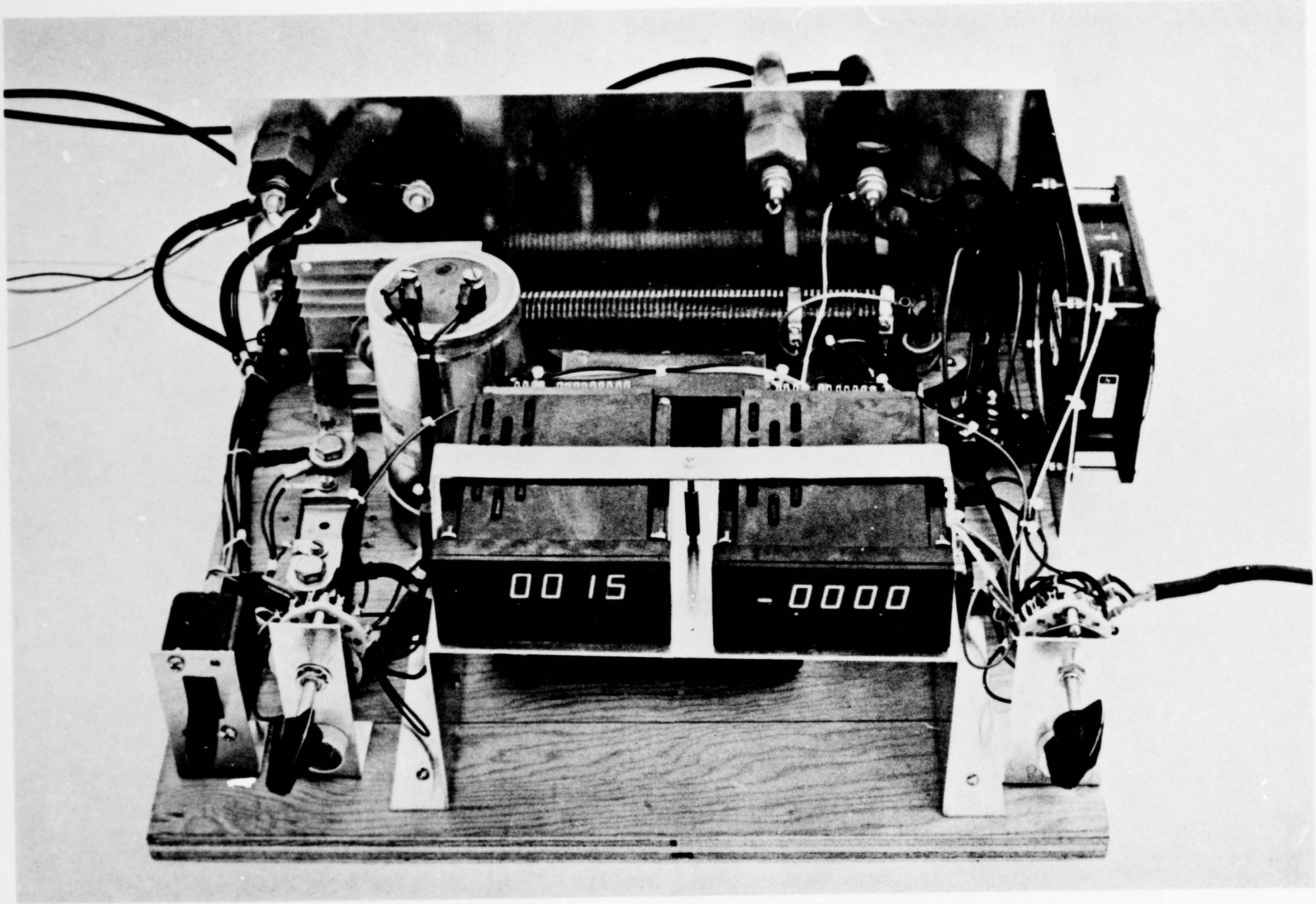
The driving circuit test device shown in Figure 7 was fabricated and calibrated. The device meets the requirements of the purchase description, and in addition, features accurate metering which is needed for lamp burn-in, ignition testing and E.I. testing. This device includes two digital panel meters. One of the meters is used to monitor lamp current, solenoid current, and stinger current. The other meter is used to monitor the lamp voltage, boost voltage and input voltage. Two panel switches are used to switch between the different monitor points. The current is monitored by using Weston meter shunts. One shunt is in series with the solenoid, one in series with the stinger, and one in series with the ballast. The resistance of the ballast, plus the total distributed resistance including the meter shunt, is 0.150 ohms $\pm$0.005 ohms measured at 51.0 amperes current flow.

3.2 FABRICATION

During this period, using the initial design, many of the subassemblies were reworked and new sealing rings were fabricated. One lamp has been fabricated and was pumped and filled. This lamp was delivered as the first engineering sample. The second engineering sample was assembled, pumped and filled during this timeframe.

3.3 TESTING

During the second quarterly reporting period the first engineering sample was tested, evaluated and prepared for shipment.



Driving Circuit Test Device

Figure 7

3.4 CONCLUSION

At the end of this reporting period, the second engineering sample had been fabricated, pumped and xenon filled. The lamp was operational, however the testing and evaluation were not performed during the reporting period.

We are quite confident that the problem areas outlined in the purpose of this report have been solved. These areas include:

1) Stinger bearings
2) Precision of electrode placement with respect to reflector and the external mounting surface
3) Lamp starting reliability

Further testing, including cycled-life testing, is needed in order to prove that the features incorporated in the second engineering sample do indeed solve the above mentioned problem areas.

4.0 PROGRAM FOR NEXT INTERVAL

1. Distribute first quarterly report.
2. Test the second engineering sample
3. Deliver the second engineering sample and test report.
4. Update drawings
5. Start the third engineering sample phase.

5.0 PUBLICATIONS AND REPORTS

None.

6.0 IDENTIFICATION OF PERSONNEL

Mr. Timothy Bell's resume has been included in this report as being a new member of the EIMAC Illuminator Group.

TIMOTHY C. BELL

Mr. Bell joined the Illuminator Division at EIMAC in November 1976. His responsibilities are to prepare and publish engineering program master schedules, cost estimates, and department manpower plans; and maintain program plans in order to assure remedial action in critical problem areas. He will assist in engineering release and engineering procurement items. Additionally, Mr. Bell will be responsible for software associated with military and commercial programs.

Before joining EIMAC, Mr. Bell was recently retired from the U.S. Marine Corps after 25 years of service; Private to Captain. He achieved progressive promotions and attendant responsibilities in the fields of logistics, ordnance and maintenance. His varied assignments have provided extensive experience in the above fields. A considerable portion of his military career was spent in executing policies pertaining to procurement, provisioning support of new items of equipment, computation of statistics to support military software, contract monitoring, and production supervision.

MANHOURS CHARGED TO CONTRACT FOR PROFESSIONAL AND SKILLED TECHNICAL PERSONNEL FOR THE PERIOD SEPTEMBER 1976 THROUGH NOVEMBER 1976.

Ed Chan	96	Hours	
Gordon Liljegren	101	Hours	
Victor Kristen	4	Hours	
George Calkins	16	Hours	
Charlie McGlew	251	Hours	
Nick Picoulin	21	Hours	
Chuek Ng	80.5	Hours	(Engineer)
Cheryl Handley	49.5	Hours	(Draftperson)
Nick Costese	1.7	Hours	(Technican)
Mike Ryan	5	Hours	(Technican)
Scott Flackman	5.1	Hours	(Technican)

Figure 8

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